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A MONOGRAPHIC STUDY OF THE GENUS CUCURBITARIA IN NORTH AMERICA[1]

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(WITH PLATES 7 AND 8 AND 5 FIGURES IN THE TEXT)

Recent studies by Fitzpatrick (**23**, **24**) have shown that certain forms of the family Cucurbitariaceae Lindau possess characters of unusual and peculiar interest. It is the purpose of the present study to investigate the genus *Cucurbitaria* in the light of these recent additions to our knowledge of the group.

The genus name *Cucurbitaria* was first used in 1821 by S. F. Gray (**29**). He described four species, three of which were subsequently removed to other genera. The remaining species, *C. Berberidis*, is considered the type of the genus. It was based on *Sphaeria Berberidis* Persoon, a well defined species, of wide distribution, commonly collected, and occurring, as far as known, only on species of *Berberis* L. The type specimen in the herbarium of Persoon is plentiful, well preserved, and has fortunately been available for study and comparison. The species commonly collected in North America on *Berberis* has been found to be identical with this.

The basis of the genus being thus well established, a study of the remaining species has been undertaken in order to determine the characters and limits of the group. The present work is

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confined to a consideration of the species which have been reported from North America, but since many European species occur in the list it is believed that the study will be representative of the genus as a whole. The total list for North America includes 77 names. These have been collected from all available sources, the list constituting a fairly complete compilation of the species of this continent. Many of the names are merely synonyms, and long recognized as such, but for the sake of completeness all are included.

The position of the genus in the scheme of classification has been well established in literature. Saccardo (**56**), using the muriform character of the spore as the basis for primary separation, placed the genus in the Sphaeriaceae-phaeodictyae, distinguishing it from the other genera of the group by the characterization "*perithecia cespitose.*" The family Cucurbitariaceae was first described by Lindau (**41**) essentially as follows: fruit-bodies cespitose, formed beneath the epidermis, later erumpent and remaining exposed, seated on a firm felt-like crust or pulvinate stroma; walls leathery or carbonaceous, compact. The family has been generally accepted and remained unquestioned until 1918 when Theissen and Sydow (**63**), following a study of the type specimen, proposed placing the genus in the Pseudosphaeriales. This order is an extension of the family Pseudosphaeriaceae of von Höhnel (**32**) founded in 1907 to include forms having a perithecium-like stroma containing groups of asci in which each ascus is enclosed in a separate chamber or loculus. Von Höhnel's characterization reads as follows: "*Stromata klein, eingewachsen, peritheciumähnlich, mit mehreren nebeneinander stehenden Loculi die je einer Ascus enthalten.*" Theissen and Sydow (**63**) in proposing the order Pseudosphaeriales made the following statement showing the importance which they attached to the characters attributed to the earlier group: "*Als vorläufig einziges Merkmal müssen wir die streng perithizienartig Fruchtkörper mit monasken Lokuli (d.h. durch gewebsfassen getrennten Asken) festhalten.*"

The proposed changes in the formation of this new order involve genera of the Pleosporaceae as well as the Cucurbitariaceae. The radical character of these changes invites a careful

scrutiny of the reasons advanced. The writer has not been able to discover any evidence of the presence of loculi enclosing single asci in the Persoon type or in any other specimen examined. Lacking a confirmation of the findings of Theissen and Sydow it is concluded that the placing of the family Cucurbitariaceae in the Pseudosphaeriales is unwarranted

During the studies included in this work it has been found necessary to make general use of hand sections of all material examined. Without these a correct interpretation of the structure of these fungi is impossible, a fact the importance of which can not be overestimated. The distinctive characters of the Sphaeriales are such as may be seen only by the use of thin sections of perithecia and stromata. Such, for example, is the only positive means of demonstrating the clypeus.

This investigation would not have been possible without the kind coöperation of mycologists and botanists both in Europe and America who aided in the obtaining of specimens for examination. Thanks are especially due to Doctor F. J. Seaver for permission to freely consult the valuable specimens in the Ellis Herbarium and other collections at the New York Botanical Garden, to Professor Roland Thaxter for likewise extending the courtesies of the Farlow Herbarium and Library of Cryptogamic Botany at Harvard University, and to Doctor Francis Pennell for permission to examine material from the Schweinitz Herbarium at the Philadelphia Academy of Sciences. The writer is also indebted to Doctor W. H. Weston for assistance in the use of the Bibliographical Index of North American Fungi maintained at the Farlow Library and to Mr. A. P. D. Piguet for valuable service in connection with the checking of the bibliography. To individuals who have generously responded to requests for material the writer owes also a debt of gratitude.

Many of the specimens examined in the course of these investigations have been returned to the original sources but some of the materials, including the writer's own collections, and all of the slides except those of material from Harvard University are deposited in the Plant Pathology Herbarium of the New York State College of Agriculture at Cornell University.

This work has been carried on under the direction of Doctor

H. M. Fitzpatrick for whose encouragement and helpful suggestions the writer wishes here to express his appreciation.

The photographs were made by Mr. W. R. Fisher and the text figures are the work of the writer.

CUCURBITARIA Gray, Nat. Arr. Brit. Pl. 1: 519. 1821

Perithecia dark brown or black, carbonaceous, turbinate, with thick walls and a thickened elongated basal extremity, erumpent, cespitose, seated on a pseudoparenchymatous stroma or a subiculum of dark brown hyphae, frequently collapsing apically at maturity but not deeply; ostiolum surrounded by a papilliform prominence, sometimes obscure, becoming perforate with age; asci cylindrical, short stipitate, thick-walled, 2-, 4-, 6-, 8-spored (mostly 8), persistent; paraphyses filiform, abundant; ascospores mostly uniseriate, ellipsoidal with 3 to 9 or more cross walls and muriform by several longitudinal septations, constricted at the middle septum, straw-yellow changing to deep olive-brown or red-brown with age. Saprophytic, at least in the perithecial stage, and growing on wood.

Varying conceptions of the limits of the genus have existed from time to time. The original description given by Gray (**29**), although brief, is yet quite suggestive of the true nature of members of the genus. "*Thallus spreading, irregular; thecae in tufts placed on the thallus.*" Greville (**30**) offers the following characterization of the genus, based on *C. Berberidis* (Pers.) Gray: "*Spherules carneous, tufted, free, fixed on a receptacle, sometimes at first included. Interior filled with a gelatinous sporuliferous mass.*"

Tulasne (**65**), who was the first to attempt a lengthy description, calls attention to the irregular occurrence of the colored mycelium merging with the fleshy fruit-bodies, the latter variously arranged in circles, ridges or tufts, emerging from the mycelium or stroma or seated on the bare substratum. The "*conceptacula*" or perithecia are described as being "*often smooth, free or confluent, raised, rugulose-tuberculate, commonly obtuse, beakless and minutely papillate or more often umbilicate, finally perforate.*" Pycnospores are described as varying considerably in shape, size, color and septation while the ascospores are said to be biloculate or "*multipartitae,*" lightly or deeply colored, smooth, muticate, monostichous in elongate, 8-spored

asci with thick walls; the paraphyses crowded. Karsten (**35**) adds little to the above except that he uses "*murali-divisae*" to describe the septation of the spores, this being the first reference to the muriform character of the ascospores now recognized as one of the important features of the genus. Saccardo (**56**) makes use of Karsten's description almost verbatim in his account of the genus in the Sylloge Fungorum. He further notes that some species having gregarious perithecia, not truly cespitose, approach *Teichospora*. Winter (**68**) calls attention to the stalk-like basal portion in some species and to the variable number of spores in the ascus (6–8). Ellis and Everhart (**16**) and Berlese (**2**) add nothing of significance to the previous accounts.

Due to the indefinite character of the early descriptions there developed several widely differing conceptions of this genus among the early American mycologists. Thus we find some, like Doctor Peck, placing in the genus any form having black cespitose perithecia, regardless of the character of the spores, while others, notably Ellis, are found regarding the muriform spore and cespitose habit together as constituting typical characters of the genus. The result has been that a large number of different forms have fallen at one time or another under the name *Cucurbitaria* and a critical examination of the species said to belong to this genus shows clearly that the group includes representatives from a number of different genera.

Preliminary to this study a general survey of the muriform-spored genera of the Sphaeriales was made from which it became evident that a great deal of confusion exists among these forms. For example, the genera to which *Cucurbitaria* appears to be most closely related according to the natural classification are *Teichospora* Fuckel (= *Strickeria* Körber) in the Amphisphaeriaceae and *Crotonocarpia* Fuckel in the Sphaeriaceae. Specimens of the type species of both of these genera have been examined and it is evident that the present conceptions of these forms do not conform with the types (PL. 8, FIGS. 7 and 8). It is beyond the scope of the present work to consider these genera further. Therefore in the treatment of excluded species the definite transfer of many of these in advance of monographic work on related genera has been purposely avoided.

In the meantime it becomes necessary to designate in some way the general character of the species which in the revision here set forth must be excluded from the genus. It is believed that this can be done best by arranging such species according to the families which they appear to represent, leaving the subject of their final treatment to further investigation.

No account of the genus would be complete without mention of the treatment accorded the group by O. Kuntze (**39**) in his stupendous work on the revision of the genera of the plant kingdom. Here the genus has been renamed according to that author's interpretation of the rules of botanical nomenclature. The alterations in so far as they apply to *Cucurbitaria* Gray consist in the assigning of the new genus name *Gibberidea* O. Kuntze to the group and changing *Nectria* Fries to *Cucurbitaria*. For this procedure Kuntze offers the following explanation. The genus as originally described by Gray (**29**) contained 4 species, viz.: *C. Berberidis* based on *Sphaeria Berberidis* Persoon, *C. cupularis* on *Sphaeria cupularis* Persoon, *C. rubra* on *Sphaeria cucurbitula* f. *flavescens* Tode, and *C. coccinea* on *Sphaeria coccinea* Persoon [= *Sph. decidua* Tode]. Subsequently the last two species were transferred by Fries (**27**) to *Nectria*, *C. cupularis* was made *Nitschkia cupularis* by Karsten (**35**) and there remained only one species, *C. Berberidis*. According to the rules as understood by Kuntze, *Cucurbitaria* Gray *ex parte majore* is *Nectria* Fries, following Art. 54, Sect. 5 of the Rules of Botanical Nomenclature (**10**) adopted at the International Botanical Congress held at Paris in 1867.

With the purpose, in view of testing the reasonableness of applying this rule in such a way, let the facts be reviewed in chronological order. Fries separated the species *rubra* and *coccinea* from the group in 1849, leaving as many species as were removed. Later when Karsten (**35**) called *C. cupularis* a *Nitschkia* the same process of dividing in two was repeated, except that in this case there was a recognizable difference in the size of the two groups. Several species of *Cucurbitaria* had in the meantime been described, Fuckel alone having given 18 species in 1869, while *Nitschkia* was a small group, containing at that time, according to Karsten (**35**), only two species. It may thus be

seen that there had been no violation of the rules prior to Kuntze even though they were *ex post facto* in the case of the first change. It is therefore concluded that the name *Cucurbitaria* Gray is acceptable according to present usage and that the genus is therefore valid.

For convenience the discussions of the doubtful and excluded species are arranged in alphabetical order under the following headings: I. Doubtful species, II. Excluded species (*A*. Species related to the Amphisphaeriaceae, *B*. Species related to the Sphaeriaceae, *C*. Other excluded species and synonyms).

KEY TO THE NORTH AMERICAN SPECIES OF CUCURBITARIA

Spores 7–9 or more septate, perithecia rough ..... 1. *C. Berberidis*
Spores 5–7-septate.
  Underlying stroma pulvinate.
    Perithecia brown ..... 2. *C. Caraganae*
    Perithecia black ..... 3. *C. Laburni*
  Underlying stroma scanty or effused ..... 4. *C. elongata*
Spores 3-septate, rarely 4–5-septate ..... 5. *C. arizonica*

1. CUCURBITARIA BERBERIDIS (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 519. 1821

Sphaeria Berberidis Persoon, Syn. Fung. 52. 1801.
Gibberidea Berberidis (Rabenh.) O. Kuntze, Rev. Gen. Pl. 3[2]: 481. 1898.

Perithecia cespitose, in groups varying from few to very many, appearing in elongated crevices of the ruptured outer bark, rough, irregular, black, turbinate to subglobose, often confluent at the base, not collapsing, 600–760 μ in diameter, walls often 70–90 μ in thickness with the outer cells opaque and black and the inner cells olive-green; ostiolum perforate; subiculum of dark hyphae which connect the pointed or stipitate bases of the turbinate perithecia, subiculum sometimes scanty, in which case there is a pseudoparenchymatous stroma connected directly with the cortical tissue; asci 150–180 $\times$ 11–15 μ, 4-, 6-, 8-spored; spores slightly pointed, 7–9 or more septate with many longitudinal divisions which impart to the mature spore a finely muriform appearance, olive-brown, 27–31 $\times$ 10–12 μ, occasionally larger in 4- or 6-spored asci. (PL. 7, FIG. 1; PL. 8, FIGS. 5, 9.)

Type collected on *Berberis vulgaris* and all the known specimens found on species of this genus.

This species is the type of the genus and is easily recognized by its rugulose perithecia and its constant occurrence on *Berberis*.

MATERIAL EXAMINED

Persoon, Type material, Nos. *910–270–291*, *910–270–261*, *910–270–301*.

Herb. D. S. Welch *35*, *36*, *37*, *352*, *358*, *361*.

Petrak, Flora Moravica (in Herb.).

Ellis, N. Am. Fungi *578* (at Cornell Univ. and N. Y. Bot. Gard.).

Ellis & Everhart, Fung. Columb. *1915* (at Cornell Univ. and N. Y. Bot. Gard.).

Atkinson Herb. 2 specimens, Berkeley coll. (at Cornell Univ.).

Krieger, Fungi Saxonici *1261* (at Cornell Univ. and N. Y. Bot. Gard.).

Roumeguère, Fung. Gall. *563* (at Cornell Univ. and N. Y. Bot. Gard.).

Rabenhorst, Fung. Europ. *2230* (at Cornell Univ. and N. Y. Bot. Gard.).

Rehm, Ascom. *281* (at N. Y. Bot. Gard.).

Sydow, Myc. March. *2943* (at N. Y. Bot. Gard.).

Plants of Southern Colorado (at N. Y. Bot. Gard.).

2. CUCURBITARIA CARAGANAE Karst. Medd. Soc. Fenn. **2**: 182. 1878

Gibberidea Caraganae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Perithecia erumpent, densely cespitose in groups 2–10 × 1–4 mm. wide, appearing elevated above the ruptured bark, smooth, dull, dark brown, turbinate, 425–550 μ in diameter, collapsing so as to appear flattened at the top, walls (in section) 50–80 μ in thickness and of a uniform dark red-brown color; ostiola papilliform, becoming perforate with age; stroma pulvinate, consisting of masses of dark hyphae in which the elongate basal portions of the perithecia are imbedded; asci 4-, 6-, 8-spored, 125–175 × 11–12 μ; spores ellipsoidal, 5–7-septate (mostly 7), pointed at both ends and slightly curved, dark olive-brown, 25–29 × 8–10 μ. (PL. 8, FIG. 4.)

Type collected on *Caragana arborescens* in Finland (Mustiala). Found also on *Elaeagnus* sp.

This species differs from *C. Laburni* chiefly in having lighter colored perithecia with smooth walls. Karsten (**36**), in his original description of the species, states that in addition to the above mentioned differences there is also one of size of groups of

perithecia but this has been found not to hold. The color differences in the perithecial walls are very striking when thin sections of the two are compared. *C. Caraganae* has a uniform color throughout, a rich dark brown, while *C. Laburni* has a wall composed of olive-brown cells with an outer layer of black carbonaceous structure. The fungus collected by Brenckle (**3**) on *Elaeagnus argentea* and cited by him as *C. Caraganae* Karst. var. *Elaeagni* Rehm appears not to differ from *C. elongata* (Fries) Grev. to which species it has been referred. Von Höhnel (**33**) states that *Pseudodichomera Elaeagni* (Karst.) v. H. (= *Dichomera Elaeagni* Karst.) is an imperfect stage of *Cucurbitaria Caraganae* Karst.

MATERIAL EXAMINED

Karsten Herb. 4 specimens, one of which is the type.
Saccardo, Myc. Ital. *490* (at N. Y. Bot. Gard.).
de Thümen, Myc. Univ. *1066* (at N. Y. Bot. Gard.).
ex de Thümen Herb. no number, coll. by Karsten (at N. Y. Bot. Gard.).
Rabenhorst, Fungi Europ. *3857* (at N. Y. Bot. Gard.).

3. CUCURBITARIA LABURNI (Pers.) de-Not. Erbar. Critt. Ital. No. *875*. 1862

Sphaeria Laburni Pers. Syn. Fung. 50. 1801.
Gibberidea Laburni O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Perithecia erumpent, densely cespitose, in irregular patches which range from 1 mm. to 1 cm. or more in diameter and often coalesce, raised above the ruptured epidermis, minutely roughened, black, turbinate, the basal portions often fusing, collapsing but slightly so as to appear somewhat flattened, 650–900 μ in diameter, walls (in section) 50–80 μ thick, cells dark olive-brown and the outer walls of the outermost cells black; ostiolum distinctly papilliform, persistent; stroma pulvinate, forming a pseudoparenchymatous cushion which merges below into a closely woven mass of dark hyphae interwoven with the tissues of the cortex; asci 180–195 × 12–17.5 μ, 8-spored; spores oblong ellipsoidal, dark olive-brown, 5–7-septate (mostly 7), 25–31 × 9–10 μ. (PL. 7, FIG. 2.)

Type collected on *Cytisus Laburni*.

This species is most closely related to *C. Caraganae* Karst. The points of difference are enumerated in the discussion of the

latter. The elongate bases of the perithecia in both species are seen only in sections cut at or near the center of the perithecium.

In the course of these studies no imperfect fungus has been found associated with this species but numerous references to such forms are found in the literature. Tulasne (**65**) describes a pycnidial stage with ovate or cylindrical, non-septate, hyaline "*stylospores*," 5–10 × 3.5–5 μ, and also another pycnidial form with spores dark, 3–4-septate, muriform, 20–30 × 7–10 μ. Fuckel (**28**) mentions also a "*fungus pycnidium*" which he calls *Diplodia Cytisi* Aud. Saccardo (**56**) suggests that *Camarosporium Laburni* Sacc. & Roum. is a pycnidial stage of *Cucurbitaria Laburni*. Von Höhnel (**33**) gives *Pseudodichomera Laburni* (Cooke & Mass.) v. H. (= *Dichomera Laburni* Cooke & Mass.) as an imperfect stage of *C. Laburni*. According to this author other forms of the same species are *Camarosporium Laburni* (West.) Sacc., *C. laburnicum* Sacc., and *C. Cytisi* Berl. & Bres.

MATERIAL EXAMINED

Persoon Herb. 3 specimens from the Rijks Herbarium, Leiden, Netherlands. Nos. *1–924–1*, *–2*, and *–3*.

Herb. D. S. Welch No. *576*.

Atkinson Herb. specimen collected in Europe by P. Magnus (at Cornell Univ.).

Roumeguère, Fung. Gall. *492*, *985* (at Cornell Univ.).

Petrak, Flora Moravica, from herbarium of H. M. Fitzpatrick (at Cornell Univ.).

Cesati & de-Notaris, Erbar. Critt. Ital. *875* (at Harvard Univ.).

Fuckel, Fung. Rehn. *965* (at Harvard Univ.).

Saccardo, Myc. Ital. *1494* (at N. Y. Bot. Gard.).

4. CUCURBITARIA ELONGATA (Fries) Grev. Scottish Crypt. Fl. **4**: tab. 195. 1826

Sphaeria elongata Fries, Syst. Myc. **2**: 422. 1823.

Sphaeria Amorphae Wallr. Fl. Crypt. Ger. **4**: 781. 1833.

Sphaeria Coluteae Rabenh. Herb. Myc. *1239*. 1849.

Cucurbitaria Coluteae Auersw. *in litt.* Fuckel, Symb. Myc. *174*. 1869.

Cucurbitaria Amorphae Fuckel, l.c.

Cucurbitaria Ailanthi Rabenh. Fungi Europ. *1833*. 1874.

Cucurbitaria Negundinis Wint. *in* Rabenhorst, Kryptogamen-Flora **1**[2]: 329. 1887.

Gibberidea Amorphae O. Kuntze, Rev. Gen. Pl. **3**[2]: 481. 1898.

Gibberidea Coluteae O. Kuntze l.c.

Gibberidea elongata O. Kuntze l.c.

Gibberidea Ailanthi O. Kuntze l.c.

Cucurbitaria Spartii (Nees.) Ces. & de-Not. forma *Sophorae* Feltg. in von Höhnel, Sitz-ber. Akad. Wiss. Wien **115**: 1217. 1906.

Cucurbitaria Caraganae Karst. var. *Elaeagni* Rehm; Brenckle, Mycologia **9**: 279. 1917.

Perithecia erumpent in elongate clusters through irregular openings in the outer bark, sometimes appearing single, surface minutely roughened, dull, black, carbonaceous, subspherical to turbinate, crowded, rarely confluent, collapsing to flat-topped, sometimes umbilicate but never deeply cupulate, 290–680 μ in diameter (mostly 340–500 μ), walls mostly 40–60 μ in thickness when seen in cross section, brown; ostiolum papilliform, appearing greyish at maturity and later collapsing; perithecia seated upon a subiculum which is composed of a mass of dark interwoven hyphae, broadly spreading and involving the cortical tissue often over large areas, these hyphae are septate and of a purple-brown color with a metallic luster; asci 120–195 $\times$ 11–15 μ (mostly 130–160 $\times$ 11–13 μ), 2-, 4-, 6-, 8-spored; spores irregularly unisériate, somewhat variable in shape and size due to the varying number found in the ascus, oblong ellipsoidal, 5–7-septate, hyaline changing to dark brown, 21–33 $\times$ 8–13.6 μ (mostly 23–27 $\times$ 9–11 μ). (PL. 7, FIG. 3.)

Type collected on *Robinia pseudacacia*, also found on *Amorpha fruticosa*, *Elaeagnus argentea*, *Elaeagnus angustifolia*, *Colutea arborescens*, *Acer Negundo*.

This is without doubt the best known of the species of *Cucurbitaria*. Striking characteristics of the species are: the flat tops of the perithecia when seen in section, the variability of the spores in shape and size and the varying number of spores in the ascus. Greville (**30**) reports as many as ten but the writer has never seen more than eight. A number of species have been merged here because of their agreement in detail with the type of *C. elongata*. Type specimens have been consulted in nearly all cases and a large number of specimens has been examined.

An imperfect fungus, *Camarosporium Robiniae* (West.) Sacc.,

is often found associated with this species, the pycnidia much like the perithecia in size, shape and structure and occupying the same relative position with respect to the stroma or subiculum. Although positive proof based on cultural or inoculation experiments is lacking it is strongly indicated that the *Camarosporium* is the imperfect stage of the *Cucurbitaria*. The pycnospores are 17–21 × 7–8 μ, mostly 3–5-septate, dark brown, muriform, ovate or oblong elliptical, somewhat irregular in shape, with no tendency to become constricted at the septa.

Tulasne (**65**) describes two types of spores in addition to ascospores. The "*microstylospores*" pale, linear-ovate, non-septate, 6.4 × 2.0 μ, the "*macrostylospores*" ovate or oblong-ovate, obtuse at the ends, 13–16 × 5–8 μ, 3–5-septate and dark brown in color. The latter fungus is evidently the same as the *Camarosporium* examined by the writer and described above although there is some difference in the length of the spores. According to Fuckel (**28**) these "*macrostylospores*" occur in the same "*perithecia*" as the asci and forms are found having 5 or even 8 septa. Von Höhnel (**33**) makes the statement that *Camarosporium Robiniae* (West.) Sacc., *C. fenestratum* (Berk. & Curt.) Sacc. and *C. Pseudoacaciae* Brun. are identical. He further determined that *Haplosporella chlorostroma* Speg. is but an immature form of this *Camarosporium*.

MATERIAL EXAMINED

Fries, Sclerom. Suec. *33*. Type, received from Fries Herbarium and also examined at Harvard Univ.

Rabenhorst, Fung. Europ. *340*, *822*, *2550* (at N. Y. Bot. Gard.).

Ellis & Everhart, N. Am. Fungi *1955* (at N. Y. Bot. Gard. and Cornell Univ.).

Ellis & Everhart, Fung. Columb. *716* (at N. Y. Bot. Gard. and Cornell Univ.).

Krieger, Fungi Sax. *769* (at N. Y. Bot. Gard. and Cornell Univ.).

Roumeguère, Fung. Gall. *564*, *2753* (at N. Y. Bot. Gard. and Cornell Univ.).

Rehm, Ascom. *336* (at N. Y. Bot. Gard.).

Ravenel, Fung. Car. 3: *56* (at N. Y. Bot. Gard.).

Beck & Zahlbr. Krypt. Exsic. Mus. Palat. Vindob. *617* (at N. Y. Bot. Gard.).

Saccardo, Myc. Ital. *1043* (at N. Y. Bot. Gard.).
Herb. C. A. King, coll. Cambridge, Massachusetts (at N. Y. Bot. Gard.).
Herb. Ellis, coll. Fairman, Lyndonville, N. Y. (at N. Y. Bot. Gard.).
Mougeot & Nestler *875* (at N. Y. Bot. Gard.).
Sydow, Myc. March. *146*, *3834* (at N. Y. Bot. Gard.).
Herb. Plant Path. Cornell Univ. *9731*, also *6989* from Meschitt coll. det. by Ellis.
Herb. D. S. Welch *40*, coll. Ithaca, N. Y.
Atkinson Herb. 2 specimens (at Cornell Univ.).
Flora Moravica (from Doctor Petrak.).

As C. COLUTEAE:

Rabenhorst, Herb. Myc. *1239*, type (at Harvard Univ.), another specimen sent by Doctor Sydow.
Rabenhorst, Fung. Europ. *2578* (at N. Y. Bot. Gard. and Cornell Univ.).
Rehm, Ascom. *637* (at N. Y. Bot. Gard.).
Roumeguère, Fung. Gall. *7317*, 2 specimens (at N. Y. Bot. Gard.).
Bartholomew, Fung. Columb. *4115* (at N. Y. Bot. Gard. and Cornell Univ.).
Krieger, Fung. Sax. *1262* (at N. Y. Bot. Gard. and Cornell Univ.).
Atkinson Herb. *19755* (at Cornell Univ.).
Herb. D. S. Welch *312*, coll. Ithaca, N. Y.

As C. AMORPHAE:

Rabenhorst, Herb. Myc. *732* (at Harvard Univ.).
Rabenhorst, Fung. Europ. *1627* (at N. Y. Bot. Gard.).
Fuckel, Fung. Rehn. *971* (at Harvard Univ.).

As C. AILANTHI (*C. Negundinis*):

Rabenhorst, Fung. Europ. *1833*, 2 specimens and *2250* (at N. Y. Bot. Gard.).

As C. CARAGANAE VAR. ELAEAGNI:

Brenckle, N. Dak. Fung. *758* (from Rehm Herb.), Fung. Dak. *306* and *477*, 3 specimens of each.
Herb. D. S. Welch *552*, coll. Brenckle.

5. CUCURBITARIA ARIZONICA Ellis & Ev. Jour. Myc. **8**: 16. 1902

Perithecia erumpent, densely gregarious, often crowded, rarely occurring singly, at maturity appearing above the ruptured bark or on the cortical tissue from which the outer layers have disappeared, dull brownish black, carbonaceous, minutely verrucose but not distinctly roughened, subspherical to turbinate, 350–500 μ in diameter, terminated by a short papilliform projection around the ostiolum, sometimes collapsing but not deeply, often becoming perforate with age, seated upon a pseudoparenchymatous stroma which frequently gives place below to a mass of densely woven hyphae of a rich brown color which mingle with the partly disorganized tissues of the cortex; asci 8-spored, 130–150 $\times$ 10–12 μ; spores obliquely and irregularly uniseriate, frequently overlapping, mostly 3-septate (rarely 4–5-septate) and muriform by one or at most two or three longitudinal divisions, straw-yellow at first becoming dark brown with a faint tinge of olive, 21–25 $\times$ 7–8 μ. (PL. 8, FIG. 6.)

This differs from *C. Astragali* Ellis & Ev. only in the possession of the turbinate character of the perithecia. Ellis gives the dimensions of the spores in his specimen as 14 $\times$ 6–8 μ.

MATERIAL EXAMINED

Griffith, West Am. Fungi *313* (at Cornell Univ.).
Ellis Herb. *type* (at N. Y. Bot. Gard.).
Brenckle, N. Dak. Fungi *775* (in Brenckle Herb.).

I. DOUBTFUL SPECIES

1. CUCURBITARIA ACERVATA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria acervata Fries, Syst. Myc. **2**: 416. 1823.
Gibberidea acervata O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Two collections of this fungus have been reported from North America. Cooke (**5**) refers to a specimen (Berk. exs. No. *174*) collected on apple in South Carolina. There is a portion of this in the von Höhnel collection at Harvard University (*A 3310* Berk. Brit. Fung. *174*) which upon examination proved to have hyaline spores. Schweinitz (**58**) reported a collection on *Populus* from Bethlehem, Pennsylvania. The spores of this were found to be hyaline and 1-celled and no asci were seen.

From the original description of this fungus as given by Fries it might be a good *Cucurbitaria*. Tulasne (**65**) has examined the de-Notaris specimen and states that it is not the same as that of Fries but resembles *C. elongata*. It has not been possible to obtain type specimens of this species and no definite conclusions can be drawn from the information at hand.

2. CUCURBITARIA CONGLOBATA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863. (Not *C. conglobata* (Fries) Karst. for which see *C. Karstenii* Sacc.)

Sphaeria conglobata Fries, Syst. Myc. **2**: 414. 1823.
Gibberidea conglobata O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Type material from the Fries Herbarium was found to be too immature for study and unsatisfactory for comparison. All the American collections referred to this species have been found to fall readily elsewhere and it is doubtful if the species is represented in America unless, as seems possible, it is synonymous with *C. Coryli*.

3. CUCURBITARIA CORYLI Fuckel, Symb. Myc. 308. 1871

Gibberidea Coryli O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Material from the herbarium of Fuckel was obtained for study but no asci or spores could be found. The perithecia were found to have thick walls and to be seated upon a definite stromatic subiculum. A specimen collected by the writer on *Corylus americana* yielded muriform spores but the perithecia in section were thin-walled and resembled *Pleospora*, as did also another collection made by Burt from *Corylus rostrata*.

The scanty evidence furnished by the above specimens and the descriptions of this species by Fuckel and others indicate a similarity to *Cucurbitaria Fraxini* Ellis & Ev. and it is suspected that further investigation will reveal that the forms found on *Fraxinus*, *Corylus*, *Betula*, *Salix*, and other similar hosts and called variously *Cucurbitaria Fraxini*, *C. Coryli*, *C. conglobata*, etc., all belong to the same species.

4. CUCURBITARIA FRAXINI Ellis & Ev. Proc. Acad. Phila. 240. 1890

Cucurbitaria Salicis Ellis & Ev. in herb.
Gibberidea Fraxini O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The specimen found in the Ellis collection at the New York Botanical Garden has deteriorated and furnishes little evidence of what the fungus might have been like. A specimen in Griffith's West American Fungi *198*, collected on *Fraxinus americana* at Aberdeen, South Dakota, has perithecia immersed at the base in the host tissue and is clearly not a *Cucurbitaria*.

5. CUCURBITARIA GLEDITSCHIAE (Schw.) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria Gleditschiae Schw. Schr. Nat. Ges. Leipzig **1**: 40. 1822.
Melogramma Gleditschiae Berk. Grevillea **4**: 98. 1875.
Cucurbitaria Gleditschiae Berk. Grevillea **4**: 47. 1875.
Botryosphaeria Gleditschiae Sacc. Syll. **1**: 463. 1882.
(?) *Otthia Gleditschiae* Sacc. Syll. **2**: 310. 1883.
Valsaria Gleditschiae Cooke, Grevillea **13**: 109. 1884–5.
Gibberidea Gleditschiae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
Trematosphaeria Triacanthi Feltg. in herb.
Cucurbitaria recuperata Theissen, Ann. Myc. **14**: 333. 1916.

Theissen (**61**) has treated this species very fully. He studied three specimens at Kew, one from Schweinitz which he assumed to be the original, and two specimens, No. *922* and Fung. Car. *942* from Berkeley's Herbarium. According to Theissen these are all identical. He states that these differ from the fungus called *Cucurbitaria Gleditschiae* by Cesati and de-Notaris (**4**) by the presence of smooth perithecia while the "*Italian*" fungus is rough "*according to the description.*" It is difficult to say what description is meant here. Cesati and de-Notaris published no description with their fungus and Schweinitz does not mention the rough character for *Sphaeria Gleditschiae*.

Theissen further states that the fungus which he studied may be distinguished from *C. elongata* (Fries) Greville only by the presence in the latter of a broadly effused stroma. From the description which Theissen has given it seems probable that his fungus is a form of *C. elongata* with scanty stroma, since it has been shown that the broadly effused character of the stroma is not distinctive for this species.

The writer has examined type material of *Sphaeria Gleditschiae* from the Schweinitz Herbarium. This specimen has 2-celled olive-brown spores and no asci are evident.

6. CUCURBITARIA HYPERICI (Schw.) Cooke, Grevillea **15**: 86. 1886

Sphaeria Hyperici Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

7. CUCURBITARIA JUNIPERICOLA (Schw.) Cooke, Grevillea **15**: 86. 1886

Sphaeria junipericola Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

(?) *Sphaeropsis junipericola* Cooke, Grevillea **15**: 80. 1886.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

8. CUCURBITARIA KARSTENII Sacc. Syll. Fung. **2**: 313. 1883

Sphaeria conglobata Fries, Syst. Myc. **2**: 414. 1823.

Cucurbitaria conglobata Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 33. 1879.

Gibberidea Karstenii O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

No American collections of this fungus have been available for study. The Karsten Herbarium has yielded some excellent material but the Saccardo specimen is practically worthless and no conclusion can be drawn as to what Saccardo had in mind when he published this species. He states that the Karsten fungus differs from *Sphaeria conglobata* Fries *in its rugulose perithecia and broader sporidia* but he fails to give the dimensions of the Friesian specimen and we have no adequate description of the *Sphaeria conglobata* of Fries.

9. CUCURBITARIA KELSEYI Ellis & Ev. Proc. Acad. Phila. **42**: 240. 1890

Gibberidea Kelseyi O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Fenestella minor Tul. *in* Berlese, Icones Fung. **2**: 77. 1900.

An examination of the type material collected by Kelsey, found in the Ellis collection at the New York Botanical Garden, indicates that the fungus is somewhat like a *Cucurbitaria* but sufficient evidence to definitely place it is at present lacking. Berlese was apparently not justified in placing this species in the genus *Fenestella*.

10. CUCURBITARIA LIGUSTRI H. Fabre, Ann. Sci. Nat. VI. **9**: 116. 1878

Gibberidea Ligustri O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

The only material of this species which has been available is an American specimen from the collection of James R. Weir in the herbarium at the New York Botanical Garden. In this specimen there are no asci but pycnidia are found in which small hyaline one-celled spores are produced in abundance. Berlese (**2**) states that this fungus is in his opinion a *Teichospora* and Fabre himself in his original description of the species says that it would have been placed in the genus *Teichospora* if the perithecia had been scattered instead of being massed together.

11. CUCURBITARIA MEZEREI Cooke, Grevillea **15**: 86. 1886

Sphaeria Mezerei Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

12. CUCURBITARIA MOLLIUSCULA Cooke, Grevillea **15**: 86. 1886

Sphaeria molliuscula Schw. Trans. Am. Phil. Soc. II. **4**: 204. 1832.

Hypocrea molliuscula Sacc. Syll. Fung. **2**: 536. 1883.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

13. CUCURBITARIA NIDULA (Sowerby) Cooke, Grevillea **15**: 86. 1886

Sphaeria nidula Sowerby, Coloured Figures of English Fungi. *pl. 394. fig. 2.* 1803. Fries, Syst. Myc. **2**: 418. 1823.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" The authorship of the species is incorrectly attributed to Schweinitz. Material has not been examined.

14. CUCURBITARIA OCCULTATA (Fries) Oudemans, Arch. Néerl. Sci. **8**: 404. 1873

Sphaeria occultata Fries, Elench. Fung. **2**: 72. 1828.

Sphaeria rugosa Wallr. Fl. Crypt. Ger. **4**: 780. 1833.

Gibberidea occultata O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

No specimens referred to this species have been seen. The type was collected on *Syringa vulgaris*. Brenckle (**3**) reports a collection on *Shepherdia vulgaris* in North Dakota. For want of further evidence regarding its character this species must be regarded as doubtful.

15. CUCURBITARIA PARASITANS Cooke, Grevillea **15**: 86. 1886
Sphaeria parasitans Schw. Trans. Am. Phil. Soc. II. **4**: 206. 1832.
This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae*." Material has not been examined.

16. CUCURBITARIA RADICALIS Cooke, Grevillea **7**: 51. 1878
Coelosphaeria radicalis Sacc. Syll. **1**: 93. 1882.
(?) *Dothiorella radicalis* Ellis & Ev. N. Am. Pyrenom. 244. 1892.
Gibberidea radicalis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
Nitschkia radicalis O. Kuntze, l.c. 501.
See Fitzpatrick (**23**).

17. CUCURBITARIA RAVENELII Cooke & Massee, Grevillea **16**: 25. 1887
Gibberidea Ravenelii O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
This species was described from a specimen collected on *Ailanthus glandulosa* at Aiken, South Carolina, by Ravenel. The material in the herbarium of Cooke, now at the Royal Botanical Gardens at Kew, was obtained for study but was found to be worthless. No other collections from *Ailanthus* are known. The host for *C. Ailanthi* Rabenhorst has been shown by Winter (**68**) to have been *Acer Negundo*.

18. CUCURBITARIA ROSAE Wint. & Sacc. Michelia **1**: 408. 1879
Gibberidea Rosae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
This species seems never to have been well understood. The examination of the material supposed to have been the type from Saccardo's Herbarium failed to shed any further light on the matter. One specimen shows only pycnidia in a Valsaceous stroma, another, in the Saccardo collection from the herbarium of de Thümen, shows no asci or spores and a third from the herbarium of G. Winter gives hyaline muriform spores. Saccardo

himself admitted the doubtful character of this species (**55**). Berlese (**2**) suggested affinities with *Pleospora*. Fairman (**21**) cites a collection from New Mexico but questions the determination.

19. CUCURBITARIA SALICINA Fuckel, Symb. Myc. 172. 1869

Gibberidea salicina O. Kuntze, Rev. Gen. Pl. **3**[2]: 481. 1898.

The specimen distributed under this name, No. *1616* Fungi Columbiani, is the only American specimen seen. A section through the perithecium shows a clypeus present. This specimen is therefore to be referred to the genus *Phaeopeltosphaeria*. A specimen from Petrak (Flora Moravica) appears to be different from the above and has spores 28–31 × 12–14 μ and mostly 7-septate. According to Fuckel (l.c.) *C. salicina* has spores 22 × 9 μ and 4–5-septate.

20. CUCURBITARIA SHEPHERDIAE (Ellis & Ev.) Ellis & Ev. North American Pyrenom. 241. 1892

Curreya Shepherdiae Ellis & Ev. Proc. Acad. Phila. **1890**: 249. 1890.

The type specimen in the Ellis collection at the New York Botanical Garden has been largely destroyed by insects. A specimen received from Brenckle, No. *1191* on *Shepherdia argentea*, collected at Kulm, North Dakota, has been examined and the perithecia are seen in section to be single and to lack a stroma, being seated directly on the cortical tissue. Theissen and Sydow (**62**) in their revision of the Dothideales assert that from its description this species seems to be a good *Curreya*. They did not examine material.

21. CUCURBITARIA SPARTII (Nees.) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria Spartii Nees in Fries, Syst. Myc. **2**: 424. 1823.
Gibberidea Spartii O. Kuntze, Rev. Gen. Pl. **3**[2]: 481. 1898.

The type of this species has not been seen and except for the record of a single collection at Newfield, N. J. (Ellis **16**), no references to American specimens have been found. The Ellis specimen is not present in the collection at the New York Botanical

Garden nor was it distributed in any of the exsiccati sets sent out by Ellis. A number of specimens from European exsiccati have been examined and it seems evident that this species can be separated from *C. elongata* only with difficulty. Lacking further evidence as to the type specimen and as to the occurrence of the species in North America the placing of this species in the doubtful group is necessary.

22. CUCURBITARIA STENOCARPA Ellis & Ev. Proc. Acad. Phila. **1895**: 420. 1896

Gibberidea stenocarpa O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

This species is known only from the type collection and the material in the Ellis Herbarium at the New York Botanical Garden is in very poor condition. It appears to have been immature when collected, which may account for the difference noted between this species and *C. typhina* Ellis & Ev. on *Rhus typhina*.

23. CUCURBITARIA STIPATA Cooke, Grevillea **15**: 86. 1886

Sphaeria stipata Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae*." Material has not been examined.

24. CUCURBITARIA ULMICOLA Fuckel, Symb. Myc. 172. 1869

Gibberidea ulmicola O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

The specimens distributed under this name in Ellis and Everhart's North American Fungi *2815* and another collection in the Ellis Herbarium at the New York Botanical Garden have been examined. These specimens are similar but they do not represent the genus *Cucurbitaria*, being without stromatic basal portion or subiculum. European material has not been available for comparison. The spores in the American specimens (46–48 × 15 μ) are larger than the spores of the European *C. ulmicola* (36 × 14 μ) and it is not likely that these are the same. The occurrence of this name in the literature of North American fungi may therefore be attributed to the incorrect determination of these specimens by Ellis.

25. CUCURBITARIA VARIA Cooke, Grevillea **15**: 86. 1886

Sphaeria varia Pers. Syn. Fung. 52. 1801.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

II. EXCLUDED SPECIES

A. AMPHISPHAERIACEAE

The following species have been excluded from the genus by reason of the fact that they all lack the turbinate character of the perithecium and a stroma or stromatic subiculum is wholly wanting, the perithecia being partially sunken in the host tissue. This group appears to be most closely related to the Amphisphaeriaceae. Some of the species have already been referred by others to the genus *Teichospora*.

1. CUCURBITARIA BOREALIS Ellis & Ev. Proc. Acad. Phila. **1894**: 334. 1895

Gibberidea borealis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The type specimen was published as Shear's N. Y. Fungi *216*. This has been examined at the New York Botanical Garden.

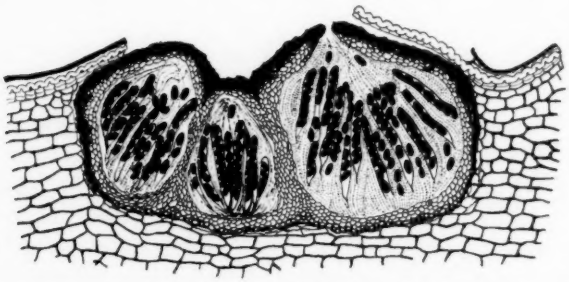

FIG. 1. *Cucurbitaria borealis.* Longitudinal section showing the relationship of the fungus to the cortical tissue of the host, *Salix* sp. (Outlined with a projection camera; × 87.) Type material.

2. CUCURBITARIA CELTIDIS Shear, Bull. Torrey Club **29**: 451. 1902

Material from the herbarium of C. L. Shear No. *383* was studied. Shear in his original description (**59**) stated that the

fungus was first referred to *Teichospora* but was finally called *Cucurbitaria* in deference to Doctor Rehm to whom specimens were submitted.

3. CUCURBITARIA COREMAE Ellis & Ev. Bull. Torrey Club **10**: 89. 1883

Gibberidea Coremae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

According to Berlese (**2**) this is a *Teichospora*. The type specimen in the Ellis Herbarium at the New York Botanical Garden has been seen and is certainly not a *Cucurbitaria*. The original collection was made on *Hudsonia tomentosa*, the host having been mistaken for *Corema Conradii*.

4. CUCURBITARIA INSECURA Ellis (?), Bull. Torrey Club **9**: 1882

Teichospora insecura Ellis & Ev. N. Am. Pyrenom. 214. 1892.
Gibberidea insecura O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The original publication of this species has not been found. The citation given above appears on the packet in North American Fungi No. *882*. The description is not to be found in the place cited.

5. CUCURBITARIA JUGLANDINA Ellis & Barth. Jour. Myc. **8**: 174. 1902

The type of this species was published as Kansas Fungi No. *2939*. A specimen of this was obtained through the kindness of Mr. E. Bartholomew. The cespitose habit, 5–10 perithecia in a cluster, as described in the original publication was not evident in this specimen.

6. CUCURBITARIA SOLITARIS Ellis, Bull. Torrey Club **8**: 125. 1881

Teichospora solitaria Ellis & Ev. N. Am. Pyrenom. 214. 1892.
Gibberidea solitaria O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
See Ellis and Everhart (**16**).

7. CUCURBITARIA TYPHINA Ellis & Ev. Jour. Myc. **9**: 166. 1903

The type specimen of this fungus was kindly supplied by Mr. E. Bartholomew. The thick-walled perithecia are immersed

only when very young and become erumpent before maturity, the basal portion remaining sunken. There is no thickening at the base of the perithecia, which appear to have been formed above empty pycnidial cavities, the latter having become shrunken and flattened by the growth of the perithecia.

B. SPHAERIACEAE

The following species lack a typical stroma or subiculum and their superficial habit indicates a closer relationship to the Sphaeriaceae than to the Cucurbitariaceae. Since the Sphaeriaceae contains at this time no well defined genus with muriform spores suitable to absorb this group, no definite placing of these forms can be made at this time.

8. CUCURBITARIA CASSANDRAE Ellis in herb.

This species was never published and is known only from the specimen to be found in the Ellis collection at the New York Botanical Garden. The perithecia are small and erumpent, with rather prominent ostiola. This species is obviously related to *C. rimulina* Fairman.

9. CUCURBITARIA COMPTONIAE Cooke & Ellis, Grevillea **6**: 12. 1877

Gibberidea Comptoniae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Four specimens from the collection of Ellis have been available for the study of this species. These have been supplemented by collections made by the writer in Ithaca, New York, and at Ausable Forks, New York, both on *Comptonia asplenifolia*. The perithecia occur singly or in groups and in most cases when they appear to be erumpent they appear above the bark only where the bark has split from other causes. Winter (**67**) has described a species which he calls *C. setosa* on *Myrica germanica*. From his description these seem to be similar but no material of the European specimens could be obtained for study or further comparison.

10. CUCURBITARIA CONGESTA Cooke & Ellis, Grevillea **6**: 12. 1877

Gibberidea congesta O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

This species is known only from the collections of Ellis of which

there are six specimens in the herbarium of the New York Botanical Garden. The collections were all made at Newfield, New Jersey, on *Magnolia*. The specimens are all very similar, the perithecia being seated on the bare wood in wounds or open places. Careful sectioning reveals that the perithecia are single and closely attached to the substratum. In habit this fungus shows distinct relationships with *C. Comptoniae*.

11. CUCURBITARIA CRATAEGI (Schw.) Ellis & Ev. N. Am. Pyrenom. 240. 1892. (Not *C. Crataegi* Niessl.)

Sphaeria Crataegi Schw. Trans. Am. Phil. Soc. II. **4**: 207. 1832.
Gibberidea Crataegi O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

The type specimen of *Sphaeria Crataegi* from the herbarium of Schweinitz has been examined and compared with the specimen in the Ellis collection at the New York Botanical Garden. Specimens were also received from Brenckle, *526* and *1195* North Dakota Fungi. All of the specimens examined are very much alike. The description of this species by Ellis (l.c.) is based partly on an examination of the Schweinitz specimen part of which appears to have been immature, since the spores are said to be yellow. It appears that the species described by Niessl (**43**) may be the same although Ellis (**16**) states that it is different, and Berlese (**2**) cites *C. Crataegi* Niessl as a synonym of *Fenestella princeps*.

12. CUCURBITARIA DELITESCENS Sacc. Michelia **2**: 252. 1882
Gibberidea delitescens O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

This species was originally described on *Persica vulgaris*. The type has not been seen but several specimens have been examined including a form collected by Brenckle on *Rubus strigosus* in North Dakota and another collected on *Prunus spinosa* by Petrak in Czechoslovakia. Morgan (**42**) also reports finding this species on *Persica vulgaris* in Ohio. This fungus is closely related to *C. Ribis* and like that species is excluded from the genus *Cucurbitaria* because of the shape of the perithecium and character of the underlying fungous tissue.

13. CUCURBITARIA ELLISII Sacc. & Syd. Syll. Fung. **14**: 607. 1899

Cucurbitaria Astragali Ellis & Ev. Bull. Torrey Club **24**: 127. 1897 (not *C. Astragali* Karsten & Hariot, Rev. Myc. **12**: 171. 1890).

Gibberidea Astragali O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Type material from the herbarium of Ellis was used in the study of this species. It was found that this fungus had no thickened basal portion and no pronounced underlying stroma or subiculum. Type material of the European form, *C. Astragali* Karst. & Hariot, was not obtained for comparison but from the several published descriptions of the latter it is concluded that Saccardo was justified in assuming that the European and American species on *Astragalus* are not the same. According to Saccardo the European fungus has spores 3–7-septate while Berlese (**2**) in his description based on material received from Hariot states definitely that the spores are 7-septate. The illustration presented by Berlese shows the spores of the Hariot fungus to be quite different from those found in the American specimen.

14. CUCURBITARIA LONGITUDINALIS Peck, Ann. Rep. N. Y. State Mus. **33**: 34. 1880

Gibberidea longitudinalis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The type of this species has been examined. The perithecia are erumpent in irregular rows running longitudinally in the bark and superficially resemble *C. Berberidis*. This fungus has no structure at all corresponding to the stroma or subiculum of the species of *Cucurbitaria*. The structure of the perithecia also indicates that this does not belong to this group. The walls are composed of two distinct layers, the outer layer is black and as far as could be seen in thin sections it has no cellular structure. The inner layer is hyaline or yellowish and composed of rather thick-walled cells.

15. CUCURBITARIA MINIMA Ellis & Ev. Bull. Torrey Club **24**: 460. 1897

Sections of the type specimen from the Ellis collection at the New York Botanical Garden demonstrated the fact that the

perithecia are here seated directly upon the bare wood. In thin sections the hyphae may be seen penetrating the wood from the base of the perithecia. This species is with difficulty separated from *C. Ribis*.

16. CUCURBITARIA NAUCOSA (Fries) Fuckel, Symb. Myc. 173. 1869

Sphaeria naucosa Fries in Kunze & Schmidt, Myk. Hefte **2**: 36. 1823.

Cenangium naucosum Fries, Summa Veg. Scand. 364. 1849.

Gibberidea naucosa O. Kuntze, Rev. Gen. Pl. **3**[2]: 481. 1898.

The original material from the Fries Herbarium has been compared with a specimen from the collection of Fuckel. These fungi are not the same and neither is a good *Cucurbitaria*. They both show characters which would place them in the Sphaeriaceae. The only American collection of which there is a record is that of Schweinitz on elm (?) at Bethlehem, Pennsylvania. Ellis has examined this specimen and reports (**16**) that it is too poor to allow him to express an opinion as to what it might have been.

17. CUCURBITARIA QUERCINA Ellis & Ev. Bull. Torrey Club **24**: 460. 1897

The type specimen, collected by Bethel on dead limbs of *Quercus undulata*, has been examined.

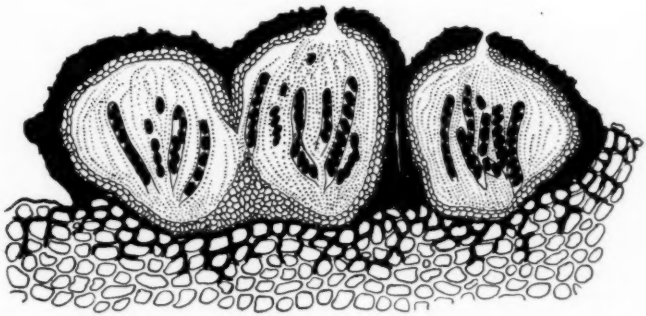

FIG. 2. *Cucurbitaria quercina*. Longitudinal section showing the position of the perithecia relative to the cortical tissue of the host, *Quercus* sp. (Outlined with a projection camera; × 135.) Type material.

18. CUCURBITARIA RIBIS Niessl, Verh. Naturfor. Ver. Brünn **10**: 198. 1871

Gibberidea Ribis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

In this species the perithecia are found mostly on the decorticated wood. Type material has not been studied but numerous exsiccati specimens have been available. From the examination of these it is clear that this species is not a *Cucurbitaria*. Other species which have characters closely resembling this fungus are *C. minima* Ellis & Ev. and *C. delitescens*.

19. CUCURBITARIA RIMULINA Fairman, Proc. Rochester Acad. Sci. **6**: 129. 1922

The perithecia in this species are flask-shaped with prominent necks. They show no thickening at the base and are seated directly on a mass of dark hyphae, loosely woven, suggesting the hyphoid subiculum of the species of *Cucurbitaria* described elsewhere. Doctor Fairman kindly sent type material from his herbarium for the purpose of this study.

20. CUCURBITARIA SORBI Karst. Myc. Fenn. **2**: 62. 1873

Gibberidea Sorbi O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Type material from the herbarium of Karsten was examined. This specimen appeared to be identical with a specimen collected by the writer on *Sorbus americana* in Northern New York. The large hairy perithecia are in cespitose clusters without enlarged

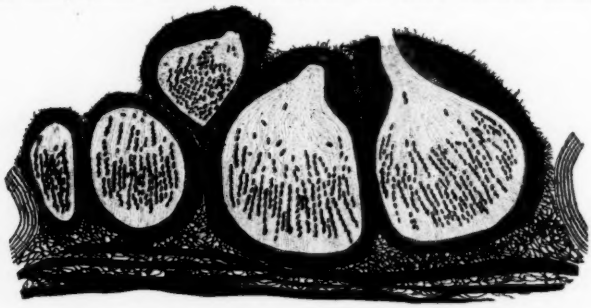

FIG. 3. *Cucurbitaria Sorbi*, on *Sorbus* sp. Longitudinal section of a group of perithecia. (Outlined with a projection camera; × 40.) Type material.

basal portion. The walls are relatively thin compared with species of *Cucurbitaria* and of uniform thickness at the basal portion, thickened around the prominent ostiola.

21. CUCURBITARIA UMBILICATA Ellis, Bull. Torrey Club **10**: 53. 1883

Gibberidea umbilicata O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

Two specimens of this fungus, one of which is the type, were examined in the Ellis collection at the New York Botanical Garden. The perithecia are scattered and occur on the decorticated wood. The opinion is expressed by Berlese (**2**) that this fungus is a *Teichospora* related to *T. pomiformis*. In the specimens examined the perithecia are not at all imbedded at the base and there seems to be no reason for placing this species in the Amphisphaeriaceae.

C. OTHER EXCLUDED SPECIES

The following group includes (1) species of various affinities and (2) recognized synonyms.

22. CUCURBITARIA ALNEA Peck, Ann. Rep. N. Y. State Mus. **28**: 75. 1876

Otthia alnea Sacc. Syll. Fung. **1**: 740. 1822.

An examination of the type specimen verified the findings of Saccardo. The spores are hyaline and two-celled.

23. CUCURBITARIA BIGELOVIAE Ellis in herb.

This specimen, collected in Colorado on *Bigelovia graveolens* by Bethel (No. *236*), was found in the Ellis collection at the New York Botanical Garden. The species was never published. The spores are olive-brown, mostly 4-septate and the perithecia possess the characteristic stalk of the *Cucurbitaria* type. The spores are not muriform and the species should therefore be placed in the genus *Gibberidea* Fuckel.

24. CUCURBITARIA BREVIBARBATA Berk. & Curt. Grevillea **4**: 47. 1876

Fracchiaea brevibarbata Sacc. Syll. Fung. **1**: 94. 1882.

Fracchiaea heterogenea Sacc. Mycol. Ven. Spec. Atti Soc. Veneto-Trent. Sci. Nat. **2**: 163. 1873.

See Fitzpatrick (**24**).

25. CUCURBITARIA CALLISTA Berk. & Curt. Grevillea **4**: 47. 1876

Fracchiaea callista Sacc. Syll. Fung. **1**: 94. 1882.

Sphaeria callista Berk. & Curt. (nom. nud.) in Rav. Fung. Car. **5**: 67. 1860.

See Fitzpatrick (**24**).

26. CUCURBITARIA CEANOTHI Dearness & House, Bull. N. Y. State Mus. **188**: 29. 1916

Material of this species collected at Albany, New York, by Doctor H. D. House and determined by him to be the same as the original collection was available for study. The perithecia in section were found to be entirely immersed in the host tissue and to possess no stroma. The walls of the perithecia were thin, this character in connection with the habit above mentioned indicating affinities with *Pleospora*.

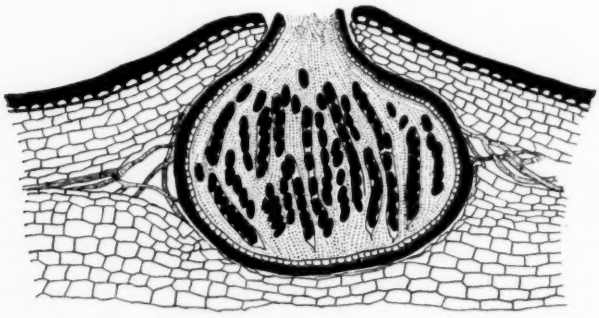

FIG. 4. *Cucurbitaria Ceanothi* on *Ceanothus americanus*. Longitudinal section of single perithecium imbedded in the cortical tissue of the host. (Outlined with a projection camera; × 120.) Type material.

27. CUCURBITARIA CINNABARINA Grev. Scottish Crypt. Fl. **3**: *pl. 135*. 1825

Nectria cinnabarina (Tode) Fries, Summa Veg. Scand. 388. 1849. (*Sphaeria cinnabarina* Tode, Fung. Mekl. **2**: 9. 1791.)

28. CUCURBITARIA CITRICOLA Sturgis. In Ellis Herb.

This specimen was found in the Ellis collection at the New York Botanical Garden. It was collected by Sturgis from *living*

orange trees at Grasum, Florida. A careful examination has shown that the fungus is growing upon scale insects rather than the orange tree. Another similar case is seen in the species *Cucurbitaria pithyophila* (Fries) de-Not. which Petrak (**49**) has recently placed in the new genus *Cucurbidothis*. The Ellis specimen was never used in publication.

29. CUCURBITARIA COCCINEA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821

Nectria coccinea Fr. Summa Veg. Scand. 388. 1849.

30. CUCURBITARIA CONFLUENS Plowr. Grevillea **5**: 74. 1876

Gibberidea confluens O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

The original specimen of this species was collected by Harkness in the Sierra Nevada Mountains, California. The type material from the herbarium of Cooke has been examined and it was found to possess a clypeus. This places the fungus in the Clypeosphaeriaceae in the genus *Phaeopeltosphaeria*.

31. CUCURBITARIA CONGLOBATA (Fries) Ces. & de-Not. var. CRATAEGI Rehm

This name appeared in a list of fungi published by Brenckle (**3**). The fungus had previously been sent to Rehm who suggested this name but it was never published. Specimens from the herbarium of Brenckle and a specimen from the Rehm collection

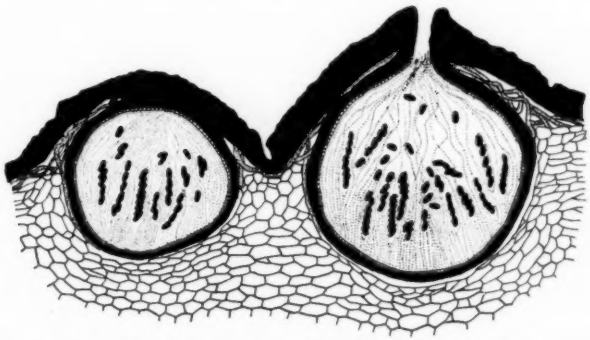

FIG. 5. *Cucurbitaria confluens*, on *Quercus* sp. Longitudinal section of two perithecia showing the clypeus, in this case continuous. (Outlined with a projection camera; × 85.) Type material.

have been examined. The spores are found not to be muriform and the species is therefore to be referred to the genus *Gibberidea*.

32. CUCURBITARIA CUPULARIS Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821

Nitschkia cupularis Karst. Myc. Fenn. **2**: 81. 1873.
See Fitzpatrick (**23**).

33. CUCURBITARIA ECHINATA Ellis & Ev. N. Am. Pyrenom. 240. 1892

Cucurbitaria setosa Ellis & Ev. (not Winter) Proc. Acad. Phila. **1890**: 241. 1890.
Berlesiella setosa Sacc. Syll. Fung. **9**: 915. 1891.
Gibberidea setosa O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The original species name of this fungus was changed by Ellis and Everhart because of the existence of the homonym *Cucurbitaria setosa* Winter (**67**). Saccardo (**56**) determined that the Ellis fungus was not a *Cucurbitaria* and he established the new genus *Berlesiella* on this species. That Ellis had some doubt about this being a good *Cucurbitaria* is shown by the fact that the type specimen in the Ellis collection at the New York Botanical Garden is accompanied by notes and a fully written description of a new genus *Dearnessia* which was never published.

34. CUCURBITARIA ERRATICA Peck, Bull. Torrey Club **34**: 349. 1907

Type material from the Peck collection at the New York State Museum was available for study. Sections of the perithecia indicated a *Cucurbitaria*-like formation, thickened base resting on a heavy subiculum. The perithecia are distinctly hairy, the ascus walls are very thick and gelatinous and paraphyses are entirely absent. Saccardo (**56**) has suggested for this fungus the genus name *Peckiomyces*. A specimen collected by Brenckle, No. *1411*, on *Prunus melanocarpa* in North Dakota seems to be the same fungus.

35. CUCURBITARIA FRAXINI var. EFFUSA Ellis & Ev. N. Am. Pyrenom. 730. 1892

In the type specimen the perithecia are completely imbedded in a loose stroma composed of the altered cortical tissue and there are empty pycnidial chambers which have long necks leading to the surface. According to these observations this species belongs to the genus *Fenestella*.

36. CUCURBITARIA MACILENTA Cooke, Grevillea **7**: 4. 1878

Wallrothiella macilenta Sacc. Syll. Fung. 1: 455. 1882.

37. CUCURBITARIA MORBOSA (Schw.) Ellis, N. Am. Fungi No. *691*. 1881

Sphaeria morbosa Schw. Schr. Nat. Ges. Leipzig **1**: 40. 1822. Fries, Syst. Myc. **2**: 417. 1823.

Plowrightia morbosa Sacc. Syll. Fung. **2**: 638. 1883.

Otthia morbosa Ellis & Ev. N. Am. Pyrenom. 251. 1892.

Dibotryon morbosum Theiss. & Syd. Ann. Myc. **13**: 663. 1915.

Cucurbitaria morbosa (Schw.) Ellis appears never to have been published as a name except on the packet label of Ellis, N. Am. Fungi *691*.

38. CUCURBITARIA OCCIDENTALIS Ellis, Bull. Torrey Club **8**: 125. 1881

Melanomma occidentale Sacc. Syll. Fung. **2**: 111. 1823.

Examination of the type material verifies the placing of this fungus in the genus *Melanomma*.

39. CUCURBITARIA PITHYOPHILA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria pithyophila Fries, Syst. Myc. **2**: 425. 1823.

Gibberidea pithyophila O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Cucurbidothis pithyophila Petrak, Ann. Myc. **19**: 198. 1921.

This species has been treated extensively by Petrak (**49**) as a member of the Dothideales.

40. CUCURBITARIA PUBENS (Schw.) Cooke, Grevillea **15**: 85. 1887

Sphaeria pubens Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

Cooke (l.c.) lists it in the section "*Sporidia 4-pluriseptata.*" In the Farlow Index it is referred to *Camarosporium pubens* (S.) n.n.

41. CUCURBITARIA SERIATA Peck, Ann. Rep. New York State Mus. **28**: 75. 1876

Otthia seriata Sacc. Syll. Fung. **1**: 739. 1882.

A part of the type collection has been examined and found to possess hyaline, 2-celled spores. The fungus is referred to *Otthia*.

42. CUCURBITARIA TUMORUM (Schw.) Berk. Grevillea **4**: 47. 1876

Sphaeria tumorum Schw. Trans. Am. Phil. Soc. II. **4**: 204. 1832.
Diplodia tumorum Ellis & Ev. North Am. Pyrenom. 243. 1892.
Gibberidea tumorum O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Material of this species was examined by Ellis (**16**) in Herb. Schweinitz and only stylospores of a *Diplodia* were found. A specimen in the herbarium of Curtis at Harvard is marked in Farlow's hand, "*shows nothing.*"

43. CUCURBITARIA VAGANS Sacc. Myc. Venet. 122. 1873

This fungus is cited by Berlese (**2**) and by Winter (**68**) as a synonym of *Fenestella vestita* (Fries) Sacc. The type specimen has not been examined but a specimen in Fungi Rhen., *954*, is found to be Valsoid. The material distributed in Rabenhorst, Fungi Europaei, is another fungus appearing much like a *Cucurbitaria*.

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EXPLANATION OF PLATE 7

Fig. 1. *C. Berberidis*, longitudinal section through a group of young perithecia. × 60. Type material.

Fig. 2. *C. Laburni*, longitudinal section through a group of mature perithecia. × 37. Type material.

Fig. 3. *C. elongata*, longitudinal section through a group of mature perithecia. × 60. Type material.

EXPLANATION OF PLATE 8

Fig. 4. *C. Caraganae*, longitudinal section through a group of mature perithecia. × 37. Type material.

Fig. 5. *C. Berberidis*, longitudinal section through a mature perithecium. × 60.

Fig. 6. *C. arizonica*, longitudinal section through a group of mature perithecia. × 60. Type material.

Fig. 7. *Crotonocarpia moriformis*, longitudinal section through a group of perithecia. × 60. Type material.

Fig. 8. *Teichospora Morthieri*, longitudinal section through a single perithecium. × 60. Type material.

Fig. 9. *Cucurbitaria Berberidis*, single ascus with spores. × 400. Type material.

4–6, 9. CUCURBITARIA
7. CROTONOCARPIA
8. TEICHOSPORA

NOTES ON THE USTILAGINEAE OF WASHINGTON

GEORGE L. ZUNDEL

The writer in 1919 published [1] a rather complete list of the Ustilaginales of Washington but since then more information relative to the distribution and host plants of several species has been collected. The purpose of this paper is to record this newly collected data.

1. TILLETIA GUYOTIANA Hariot, Jour. de Bot. 14: 117. 1900.

This species was first described by Hariot in 1887 as *Thecaphora guyotiana* but in 1900 he changed the name to *Tilletia guyotiana*. The smut was first reported from North America by the writer [1] in 1919 who reported it from Klickitat and Walla Walla counties, Washington. Since that time the following additional collections have been made:

On *Bromus hordeaceus* L.

(*a*) Endicott, Whitman County, Washington, July 14, 1920 (rare), collected by George L. Zundel.

(*b*) Campus of the State College of Washington, Pullman, Whitman County, Washington, July 3, 1921 (rare), collected by Zundel.

(*c*) Pullman, Whitman County, Washington, south on hillside, July 30, 1921 (rare), collected by Zundel.

(*d*) Moscow, Latah County, Idaho; 2 miles south of Cedar Mountain on foothills of Moscow Mountains (25–85 per cent infection), October 3, 1925, collected by George L. Zundel and E. E. Honey. This is the first recorded collection of this smut from the state of Idaho.

(*e*) Garfield, Whitman County, Washington, south ½ mile on Colfax road (25–98 per cent infection) October 8, 1925, collected by Zundel.

2. TILLETIA RAUWENHOFFII Fisch. v. Waldh. Aperçu Syst. Ust. 50. 1877.

Syn. *Tilletia Holci* (Westend.) Rostrup. 1913.

This smut has been reported from Belgium, Denmark, Great Britain, New Zealand. In 1919 Jackson reported it from Oregon and the writer reported it from Cowlitz County, Washington, in

[1] ZUNDEL, GEORGE L., Some Ustilagineae of the State of Washington, Mycologia **12**: 275–281. 1919.

the paper [1] to which reference has already been made. Since then, this smut has been found in the following new localities:

On *Holcus lanatus* L. [*Nothoholcus lanatus* (L.) Nash].

(*a*) Near city dock, Anacortes, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

(*b*) On Great Northern right-of-way, Mt. Vernon, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

(*c*) West of Mt. Vernon 1½ miles, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

3. USTILAGO BROMIVORA (Tul.) Fisch. v. Waldh. Bull. Soc. Nat. Mosc. **40**[1]: 252. 1867.

This smut is very common on the genus *Bromus* in Washington but not until recently has it been collected on *Bromus tectorum*. The following collections have been made during 1924 and 1925:

On *Bromus tectorum* L.

(*a*) Oroville, Okanogan County, Washington. ¾ mile north on Great Northern Railroad, June 29, 1924 (rare), collected by Zundel.

(*b*) Sharon, Spokane County, Washington, July 31, 1924 (rare), collected by Zundel.

(*c*) Pleasant Prairie, Spokane County, Washington, August 1, 1924 (rare), collected by Zundel.

(*d*) Foothills, Spokane County, Washington, August 1, 1924 (rare), collected by Zundel.

(*e*) Pasco, Franklin County, Washington, on the farm of H. A. Small (rare), August 19, 1924, collected by Zundel.

(*f*) Pullman, Whitman County, Washington, September 10, 1924 (rare), collected by A. Floyd Heck. (Plant Path. Herb. No. C. S. *1469*.)

(*g*) Side of highway, South Moran, Spokane County, Washington, July 31, 1924 (rare), collected by Zundel.

(*h*) Mill Creek, Walla Walla County, Washington, August 13, 1925 (rare), collected by Zundel.

(*i*) West side of State College of Washington Campus, Pullman, Washington, Whitman County, August 19, 1925 (very rare), collected by Zundel.

(*j*) Upper Blue Creek, Walla Walla County, Washington, August 21, 1925 (10–85 per cent infection), collected by Zundel.

(*k*) Foot of Badger Mountain, 2 miles s.w. of Waterville, Douglas County, Washington, September 10, 1925 (25–40 per cent infection), collected by George L. Zundel and C. E. Hill.

(*l*) McGee flats, west of Silver Lake, Pullman, Whitman County, Washington (rare), September 22, 1925, collected by Zundel.

(*m*) South ½ mile on Northern Pacific railway, Pullman, Whitman County, Washington, October 2, 1925 (one panicle smutted), collected by Zundel.

(*n*) Little Almota Creek Canyon, Almota, Whitman County, Washington, October 10, 1925, collected by E. E. Honey:

Ustilago bromivora macrospora Farlow has previously been reported from Lake Chelan, Chelan County, Washington, on *Bromus tectorum* L. by Weir. (Weir No. *12496*.)

4. SPHACELOTHECA HYDROPIPERIS (Schum.) de Bary, Vergl. Morph. Biol. Pilze 187. 1884.

On *Polygonum hydropiperoides* Michx. var. *psilostachya* H. St. John, Seaview, Pacific County, Washington, July 11, 1924. Common in ditches and ponds of the cranberry bogs. Collected by George L. Zundel and D. J. Crowley. (Host was determined by H. St. John of the Botany Department.)

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THE PROBLEM OF TERMINOLOGY IN THE RUSTS[1]

J. C. Arthur and F. D. Kern

There is today more or less confusion regarding the use of terms for the various vegetative and fruiting structures in the plant rusts. Twenty years ago the senior author pointed out (Bot. Gaz. **39**: 219–222. 1905) that the terminology then in use was "clumsy, ambiguous, poorly correlated, and quite inadequate to show homologies properly." This remark referred to the old terms *aecidium*, *uredo*, *teleuto*, etc., and their derivatives. At that time the terms *aecium*, *uredinium*, *telium*, etc., were proposed. These newer terms have been more or less widely used, but there has not been the uniformity in their application which is desirable. While the newer terms resemble the older ones they are not identical with them and are not designed merely to replace them. It is believed that the newer terms have a significance never possessed by the older terms and which the older terms cannot now be made to assume. But a matter of far more fundamental importance than the selection of the terms themselves is the outlining of concepts which are to be the basis for applying terms. For the sake of brevity it seems possible to develop a number of conceptions in the form of dicta. They are as follows:

1. The conception of rusts should give consideration both to the vegetative body (mycelium) and to the fruiting structures (sori) which arise from it.

2. The vegetative body is either long-cycle (macrocyclic), consisting of two unlike and discontinuous generations, or short-cycle (microcyclic), consisting of one continuous generation.

3. The fruiting structures, the sori, containing spores that are either inefficient, having no capacity to bring about infection, or efficient, containing spores having the capacity to bring about infection.

4. The inefficient sori (pycnia) are present or absent in both

[1] Read before the Mycological Section of the Botanical Society of America at the Kansas City meeting, December 30, 1925.

Joint contribution from the Botanical Department of Purdue University Agricultural Experiment Station and the Botanical Department of the Pennsylvania State College.

macrocyclic and microcyclic rusts, in the former only with the first generation.

5. The sori with efficient spores in a macrocyclic rust are the essential initial forms (aecia) and the essential final forms (telia), with which may or may not be associated intermediate repeating forms (uredinia); the efficient sori in a microcyclic rust resemble either the macrocyclic aecia or they resemble the macrocyclic telia, and may be designated by the same terms.

While some of these principles have been generally recognized they have not been formulated heretofore in this manner.

The point brought out in the first dictum does not need detailed elaboration. It is intended merely to draw attention to the fact that we often fall into the habit of talking about rusts as if they were collections of sori, instead of minute plants bearing fruiting structures.

For some time it has been recognized that rusts may be divided into two classes: (1) long-cycle and (2) short-cycle. We are indebted to Dr. G. Lagerheim, of Stockholm, for the suggestion of the terms *macrocyclic* and *microcyclic* which seem to us to be very appropriate and satisfactory. Heretofore, the separation into these two classes usually has been on the basis of the spore-forms produced. The second dictum points out that the logical separation is on the basis of the vegetative body. It is believed that as here stated it should be acceptable to most mycologists. A macrocyclic rust is said to have two unlike and discontinuous generations. The question whether these represent gametophyte and sporophyte need not be settled in order to permit a satisfactory arrangement of our terminology. The same is true regarding the nature of the single continuous generation in the microcyclic rusts.

In the third dictum it is pointed out that some of the sori bear spores incapable of infection while others bear spores capable of infection. It is proposed to use the term *pycnium* for the sori with inefficient spores. Neither the term nor the manner of defining it raises the question whether or not these are vestigial sex organs. On that point each worker may entertain his own views. The important point in this connection is that these inefficient fruiting structures are in all structural essentials *sori*, whatever may be their origin or function.

The fact that the pycnia may be present or absent in both macrocyclic and microcyclic rusts is so well known that further comment is unnecessary. The significance of their presence or absence is another question not necessarily to be discussed in this connection.

The fifth dictum states that there are two efficient spore-forms essential to a macrocyclic rust, the initial form and the final form. A third efficient but unessential form is the intermediate repeating stage, which is not always present. For the sori of the initial spore-stage, which vary in form in different rusts, it is proposed to use *aecium* as a general term. The structures included here are often called by various special names according to form, being derived from form-genus names. When there is a cupulate peridium with catenulate spores, *aecidium* is used; if the peridium is blister-like, the structure is a *peridermium;* if there is no peridium and the spores are catenulate, *caeoma* is the term; if there is no peridium and the spores are stylosporic, it has been customary to call the structure a *primary uredo.* The use of " primary uredo " in this connection is unfortunate since there are cases where the first sori produced of the genuine repeating stage are different in appearance from the later sori and the term *primary uredo,* if useful at all, would be applicable here. It seems most logical and serviceable to have a common term for the sori of these several initial stages which have been passing under the various terms, aecidium, peridermium, caeoma, roestelia, and "primary uredo." These and other old terms may still be useful although often confusing or inadequate. They are largely founded on gross structural characters which in themselves are insufficient to delimit any sorus. For example, an ordinary description of a caeoma structure might apply in one rust to the initial spore-stage while in another it might apply to the repeating stage. To say *caeomoid aecium* would carry with it a definiteness of nature which is desirable in analyzing these complicated species. The intermediate repeating stage has been called the uredo-stage and there is less confusion regarding the situation here than in the initial stage. The chief objection to *uredo* is that the same word is doing duty as a form genus and that it does not lend itself to the making of a uniform set of derivatives as does the term *uredinium.* For the sorus of the final spore-

stage which ends the life cycle in all macrocyclic rusts, although only produced at long intervals in some species, the term *telium* seems most acceptable. It refers to a single sorus which in the older terminology is called a teleutosorus or teleutospore-sorus. Speaking collectively, *telial* stage replaces the awkward term teleutospore-stage.

As pointed out in the Botanical Gazette paper twenty years ago it is necessary to say in the older terminology that aecidia appeared, after a time they were followed by the uredo, and finally the teleutospore stage was developed. For the three stages representing analogous spore-structures three different types of terms are required. In the newer terminology it is possible to say that aecia appeared, and that they were followed in turn by uredinia and telia. These terms can be used in the singular or plural, in the adjective form, or in combination with spore. It can be justly claimed that they do away with ambiguity and permit a conciseness and uniformity of statement not possible with the older terms.

Turning now to the microcyclic rusts it is pointed out in the fifth dictum that they have but one type of sori with efficient spores, which in some rusts resemble the macrocyclic aecia, and in others the macrocyclic telia, and that they may be called respectively aecia and telia. This is interpreted that the sori and spores in a species of *Endophyllum* may be called aecia and aeciospores, and in a species such as *Puccinia Malvacearum* they may be called telia and teliospores.

During the summer of 1925 the authors had the good fortune of discussing some of the problems here presented with numerous mycologists at home and abroad. This statement is made not to intimate that these conclusions represent in any sense a consensus of opinion but to acknowledge that this presentation has been influenced by the ideas and suggestions gained from the conferences with our colleagues. We realize, as has been pointed out to us, that scientific terms like ordinary language expressions are not dictated from ideals but gain standing by usage. It has seemed to us worth while, nevertheless, to make a contribution which may have its effect on usage.

NOTES AND BRIEF ARTICLES

Professor T. H. Macbride has been spending the winter in Washington and Southern California, his time being devoted to a continuation of his studies on the North American slime-moulds.

Professor C. R. Orton of Pennsylvania State College delivered a lecture at the New York Botanical Garden on November 14, the subject being "Seeds as Carriers of Disease." Dr. Orton is spending the present year at the Boyce Thompson Institute prosecuting research work along this line.

Professor H. H. Whetzel, accompanied by the Editor of this periodical, spent one month during the winter in Bermuda in continuation of the study of the fungi of those islands. A more extended account of this expedition will appear in a later issue of MYCOLOGIA.

Early in November Dr. W. A. Murrill left his home in Virginia for Green Cove Springs, Florida, where he planned to spend several weeks collecting fungi and enjoying the mild climate of the south.

MYCOPHAGY

The title of this brief note is applied to one of the most popular phases of mycology, *i.e.*, the eating of fungi. There is probably no question with which the mycologist is more frequently confronted than "How do you tell a mushroom from a toadstool?" The interrogator invariably has in mind some "fool proof" rule by which an edible fungus may be distinguished from a poisonous one. So far as we are aware there is no such infallible test, although many an amateur will assure you that he has one.

The only sure test is to try and this may have disastrous results. The best procedure is to gradually become acquainted with the edible forms so that one can recognize them as he would his

friends, by their features. This may be a slow process but it is the safest rule to follow. It may be best at first to confine one's experiments to a few well characterized species. When a new one is encountered that looks promising, proceed cautiously until sure of one's ground.

In order to assist the beginner Dr. W. A. Murrill, formerly editor of MYCOLOGIA, has prepared a colored chart of the most common edible and poisonous species with a descriptive handbook to accompany it. These may be purchased through this institution or directly from the agents.[1]

Under the heading of "Mycophagy" we will be glad to publish in MYCOLOGIA original notes or observations on the merits of the various species of fungi, as articles of diet. Personal experiences whether favorable or otherwise are acceptable and would doubtless be of value to others who are interested in this phase of mycology.

F. J. SEAVER.

FUNGOUS DISEASES OF FRUIT TREES AND THEIR REMEDIAL TREATMENT, BY G. H. CUNNINGHAM[2]

This is an excellently printed book of 382 pages. It is dedicated to the veteran Australian plant pathologist, Daniel McAlpine. In his preface the writer states that this work is based upon five years of study of the fungous diseases attacking commercial orchards in New Zealand. Considering the relatively short period that the author has thus devoted to these diseases his work appears to be exceptionally accurate and complete. The material is well organized and fully illustrated with drawings and fine photographs. The book is divided into two sections. First a general section dealing with such matters as the geography and climate of New Zealand, the elementary botany of fruit trees, wounds and wound treatment, the structure and physiology of fungous and bacterial pathogenes and some four general chapters on control method for diseases of fruits.

The second section is taken up with a detailed consideration of the most important fruit diseases occurring in the islands.

[1] Kny-Scheerer Corporation, 119 Seventh Avenue, N. Y. City.

[2] Published under the authority of the New Zealand Fruit Growers Federation. Brett Printing and Publishing Company, Auckland, New Zealand, 1925.

There are some 17 chapters in this part. These are divided into three groups: the first on diseases of pome fruits; the second on diseases of stone fruits; and the third on diseases of citrus fruits. Each group of chapters is introduced by an artificial key, for determining these diseases, based upon symptoms. Thirty different diseases of pome fruits are treated in considerable details. For stone fruits twenty-three diseases are so treated and of citrus fruits seventeen diseases receive special treatment. Of special interest to American pathologists is his discussion of the fire blight which has recently appeared in New Zealand and has proven very destructive. The arrangement of the data with respect to each disease is, in general, first a historical review, particularly with respect to the disease in New Zealand. Then follows a brief description of the symptoms, in most cases illustrated with excellent photographs. A short paragraph is devoted to the economic importance of the disease and the life history of the pathogene. Control is dealt with in a concise but adequate manner. For the more important diseases a short summary concludes the discussion. There is an excellent bibliography with an index of suscepts and pathogenes. It is a book which every worker on the diseases of fruits should have at hand. Since a large number of these diseases in New Zealand occur in this country the book will be found especially useful for American workers.

H. H. WHETZEL